



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>E21B 17/043, 31/00</b>	<b>A1</b>	(11) International Publication Number: <b>WO 98/32946</b> (43) International Publication Date: 30 July 1998 (30.07.98)
--	-----------	---

(21) International Application Number: PCT/NO98/00012  
(22) International Filing Date: 14 January 1998 (14.01.98)  
(30) Priority Data: 970335 27 January 1997 (27.01.97) NO  
(71)(72) Applicant and Inventor: BJØRNSTAD, Thor [NO/NO]; Lande, N-4500 Mandal (NO).  
(74) Agent: HÅMSØ, Borge; Håmsø Patentbyrå Ans, P.O. Box 171, N-4301 Sandnes (NO).

(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

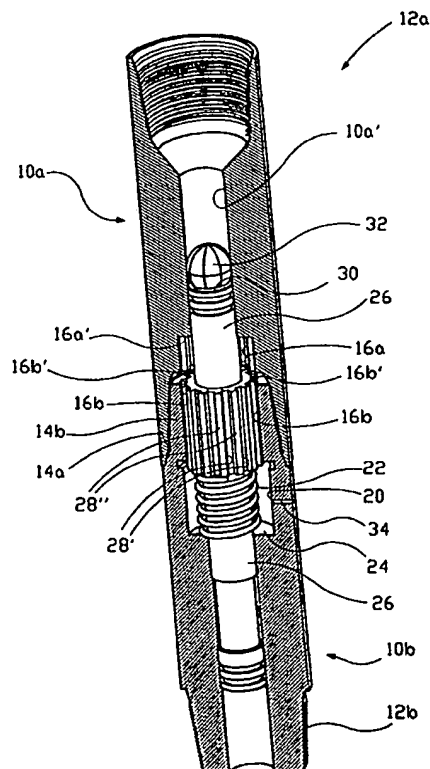
Published

With international search report.

(54) Title: A RELEASE EQUIPMENT FOR A DRILL STRING

## (57) Abstract

A release piece for a drill string is adapted to disengage upon activation in connection with a bit stuck in the lower portion of the bore hole during drilling. An elongated tubular release piece (10a, 10b) is, at the ends (12a, 12b) thereof, formed to be coupled into the drill string, upstream the bit. The drill string release piece comprises two substantially coaxial sleeve parts (10a, 10b) disposed in the continuation of each other and screwable together, said sleeve parts (10a, 10b) internally being provided with axially directed locking means (16a, 16a', 16b, 16b'). An internal, axially displaceable locking device (18) has locking means (28', 28'') capable of cooperating lockingly with said locking means (16a, 16a', 16b, 16b') of both sleeve parts (10a, 10b), the locking position being maintained by means of a spring (22). In a drill string release situation, the spring action is neutralized, the drill string, thereafter, being rotated in order to unscrew the two sleeve parts (10a, 10b) from each other, whereafter the drill string can be hauled up.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

## A RELEASE EQUIPMENT FOR A DRILL STRING

The present invention relates to a release equipment or accessory for a rotating drill string, said drill string release accessory being adapted for activation in order to release and disengage the drill string, e.g. upon a wedged bit situation or other situations where an accessory is stuck in a bottom hole position.

At high drilling speeds, e.g. 100 metres per hour, there exists a particularly great risk for the bit to get wedged and stuck in the formation in which drilling is carried out. There are examples where several thousand metres of drilled hole have been lost in connection with such wedged and unsuccessful drill string release situations. When such situations arise, it is important to have the drill string released as rapidly as possible and, thereafter, to return to ordinary drilling without having lost too much old bore hole.

If the bit wedges itself or get stuck in some other way in the formation in which drilling is carried out, one will, at first, try to pull the bit free in an upward direction, by means of the drill string. Often, this cannot be done and, therefore, in order to get the drill string released, explosives in the form of an explosive charge suspended from a wire are pumped down to the place where the bit is wedged, in order to free the stuck bit through blasting to pieces a drill string portion above the stuck bit.

CONFIRMATION COPY

Thus, conventional and other known technology comprises, first of all, the use of explosives and the utilization of blasting technique. Primarily, this is time-consuming because it takes time to mobilize accessories and personnel. Additionally, the blasting in itself represents a risk moment, namely upon unintentional blasting to pieces the surrounding formation and destructing old bore hole.

According to the present invention, one has aimed at providing a release device adapted to be coupled into a drill string in order to, using simple and cheap means as well as non-complex operational steps, enabling the release of the bit or other bottom hole equipment, respectively, avoiding the large time delays associated with the prior art.

In accordance with the invention, this is realized by means of a drill string release piece such shaped and designed that it exhibits the features as defined in the characterizing clause of claim 1.

Such a release piece is elongated and has a longitudinal symmetry axis. It comprises two at adjacent end portions interscrewable sleeve parts having coaxial, axially through-going bores and each, at the opposite end thereof, is shaped in order to be connected to an opposing end portion of an upstream drill string section and an end portion of a downstream drill string section extending down to the bit, respectively.

The elongate release piece may be positioned in the neighbourhood of the bit or other bottom hole equipment.

If right-hand threads have been chosen for adjacent, interscrewable drill pipe sections incorporated in a drill string, preferably left-hand threads are chosen for the threaded connection between the release piece's two screwable/unscrewable sleeve parts.

In the release piece is, as an essential component, included a locking device comprising locking means cooperating partly with locking means associated with one sleeve part, partly with locking means associated with the other sleeve part, a force-exerting means, preferably a spring, e.g. a pressure spring in the form of a screw spring, maintaining the locking device in the locking position and, thus, the cooperating locking means in mutual engagement until it intentionally is created a counter force which is larger than the holding force yielded by said pressure spring.

The locking device of the release piece may have the form of a separate, elongate, tubular element having an axially through-going bore. The locking means thereof may consist of an axially directed roller having a gear wheel-like cross-sectional shape, exhibiting parallel, longitudinally extending grooves equidistantly distributed circumferentially and intermediate, list-shaped projections (teeth). In principle, the locking device of the release piece comprises at least one longitudinal projection and/or at least one longitudinal groove.

Then, the locking device's at least one longitudinal projection/groove will cooperate with one locking means in the form of a longitudinal groove/projection assigned each of the sleeve parts, but it is preferred that the locking device as well as each of the sleeve parts have several parallel locking means in the form of longitudinal grooves and therein engaging, substantially complementary projections, preferably equidistantly distributed around the circumference of the locking body of the locking device and with locking means disposed along the internal circumference of cavities in the screwing area, for said locking body.

One of these cavities has a radially directed stop face against which one end of said spring rests supportingly.

The tubular locking element/device is axially displaceably

mounted in the aligned bores in the sleeve parts, the locking means of the locking body are being kept in engagement with corresponding locking means internally assigned the sleeve parts which are screwed together, said spring acting as a force-exerting safety means which secures the mutual engagement of the locking means and, thus, the the locking action.

In a drill string having a release device of the invention mounted therein, positioned just above the bit, and where the drill string is rotary, the upstream portion (above the bit) of the drill string may rapidly and simply be released from the stuck bit through the release device according to the invention, in the following way:

One end of the tubular locking device, i.e. the upper end in the position of use, is, preferably, formed with a circumferential, upwardly facing seat for a ball-shaped body having a somewhat larger circumference than that of the seat, or a similarly shaped and dimensioned closure means, e.g. a plug, which can be dropped from a surface position.

After said ball has landed in the upper seat of the tubular locking device, the pump pressure - representing a counter force acting against the spring - is increased to exceed the spring force. Thus, the spring is compressed, allowing displacement of the locking device. Upon this displacement of the tubular locking device in the downstream direction, the locking engagement between locking means assigned to the upstream sleeve part and locking means assigned to the locking device is neutralized. The axial length of engagement between these locking means is originally, preferably, somewhat less than the axial degree of compression of the spring. The pressure spring can be biased such that e.g. 200 bar excess pressure must be utilized before said locking means become disengaged.

Subsequent to the situation when the two sleeve parts are no

longer locked to each other, the drill string is rotated such that the adjacent, threaded end portions on the sleeve parts are unscrewed from each other, whereafter the lower sleeve part becomes connected to the stuck bit and possible other down hole asseccory only, while the upper sleeve part becomes connected to the upstream drill string only and will be hauled up therewith.

A non-restricting example of a preferred embodiment is further explained in the following, reference being made to accompanying drawings, in which:

Figure 1 shows an exploded view of four parts included in the release device as well as a ball-shaped body used in order to close the axially through-going bore through the release device;

Figure 2 shows the release device, parts seen in an assembled, locked, secured position, partially in axial section, partially in side elevational view;

Figure 3 corresponds to figure 2, but here the locking is nullified, previously cooperating, mutually engaging locking means (in upper sleeve part and on locking device) being pushed out of engagement, the upper sleeve part's locking means being disengaged.

First, reference is made to figure 1, in which reference numerals 10a og 10b denote two sleeve parts adapted to be screwed together. Upon vertically or approximately vertically drilling, the sleeve part 10a constitutes the upstream sleeve part and the sleeve part 10b the downstream sleeve part, referred to a downhole bit or another bottom hole accessory (not shown) at the end of a drill string (not shown), into which the shown release piece 10a,10b is coaxially inserted. For the connection to the drill string, each sleeve part 10a and 10b, respectively, has a threaded end portion in the form of an internally threaded end portion 12a on the upstream

sleeve part 10a and an externally threaded end portion 12b on the downstream sleeve part 10b, respectively.

The upstream sleeve part 10a has an internal, axially inwardly tapering, conical, threaded socket portion 14a adapted to be screwed together with an external, axially outwardly tapering, conical, threaded pin portion 14b formed on the end portion of the downstream sleeve part 10b, which internally thereof is formed with a cylindrical bore formed with longitudinal, parallel grooves 16b and intermediate, list-shaped projections 16b' directed radially inwardly, the projections 16b' in the exemplary embodiment being distributed equidistantly in the circumferential direction of said cylindrical bore. These alternating projections 16b' and grooves 16b constitute locking means to be further described later in connection with corresponding locking means formed in the other sleeve part 10a and on a special locking device generally denoted at reference numeral 18.

Axially inwardly of the internal cylindrical portion in which the locking means 16b, 16b' are formed, a spring room 20 has been formed in the downstream sleeve part 10b, accommodating a pressure spring in the form of a screw spring 22 or another force-exerting means, e.g. a rubber-elastical means, said spring room 20 being defined by a radial stop face 24, against which one end of the pressure spring 22 rests supportingly in the position of use thereof.

Axially inwardly of its threaded end portion 14a, the upstream sleeve part 10a has an internal cylindrical portion having locking means 16a, 16a' similar to those of the downstream sleeve part 10b.

In the present exemplary embodiment, the groove-shaped locking means 16a and 16b of the sleeve parts 10a and 10b are aligned with each other in the axial direction of screwed-together sleeve 10a,10b.



Said locking device 18 is constituted by an elongate tubular body 26 having a through-going bore and a fixed locking body 28 having a gear-wheel-like cross section, formed complementarily to the locking portions 16a, 16a' and 16b, 16b' internally within the sleeve parts 10a, 10b. In the shown exemplary embodiment, the longitudinal, parallel grooves 28' in the locking body 28 of the locking device 18 extend axially aligned with the locking projections 16a', 16b' of the sleeve parts 10a, 10b, while the longitudinal, list-shaped projections 28" positioned intermediate the grooves 28' extend in alignment with the parallel, mutually aligned grooves 16a, 16b of the sleeve parts 10a, 10b. Upon the assemblage of the sleeve parts 10a, 10b and the locking device 18, said grooves and projections are brought into engagement with each other, so that the elongated, longitudinal projections 28" of the locking device 18 mesh displaceably into the internal, elongated, longitudinal grooves 16a, 16b of the sleeve parts. The spring 22 maintains this locking engagement of the locking means 16a, 16b, 28", 16a', 16b', 28' when it occupies the inserted operative position, figure 2.

It appears immediately that the locking means 16a, 16b, 28", 16a', 16b', 28' prevent a rotation of the sleeve parts 10a and 10b in relation to each other, so that their screwing-together at 14a, 14b can not be nullified as long as the spring 22 is not compressed axially.

Advantageously, the upstream end of the elongated, tubular part 26 of the locking device 18 may be formed with a seat 30 for a ball-shaped body 32 having a somewhat larger diameter than the largest internal diameter of the seat 30.

If a bit, not shown, connected below the downstream sleeve part 10b, preferably through an intermediate drill string portion (not shown), wedges itself and get stuck in the formation, the release device 10a, 10b is activated through the drop of the ball-shaped body 32 down through the drill string (not shown), guided by the bore 10a' of the upstream sleeve

part 10a to rest sealingly against the seat 30, figure 3. Thus, the axial passage through the release piece 10a,10b is closed, and the ball's 32 upper half forms a reaction face for an increased pump pressure which is caused to increase until it exceeds the spring force. Then, the spring 22 is compressed and allows longitudinal displacement movements of locking means 16a, 16a', 16b, 16b', 28', 28", until the locking device's 18 locking means 28', 28" have been pulled out of their engagement with the locking means 16a, 16a' of the upstream sleeve part 10a, resulting in a neutralization of the rotation-preventing engagement between certain locking means. When, thereafter, the drill string (not shown), which is connected to the release piece 10a,10b,18 through the upstream sleeve part 10a, is rotated from a surface position, the sleeve parts 10a, 10b are unscrewed from each other, and the drill string can be hauled up.

Into the spring room 20 extends a narrow oil filling gate 34. Through this gate, one may pressure-test whether or not the release piece is sealed and tight, i.e. in order to control that packers (not shown) are in order. Reference numerals 36, 36', 36'' and 36''' denote grooves formed in the locking device 18 and serving to accommodate seals (O-rings). The room 20 may be filled with oil in order to preserve both the spring 22 and locking means. The oil filling gate 34 may be provided with threads so that it may be closed by means of a screw, not shown.

## C l a i m s

1. A release piece of the kind intended to be joined coaxially into a drill string, and adapted to be activated in connection with a drill string being stuck, e.g. through a wedged bit, comprising two in the continuation of each other disposed, substantially coaxial sleeve parts (10a, 10b) which can be screwed together at adjacent end portions 14a, 14b, and which internally are equipped with longitudinal tooth-/intertooth-space-like locking means (16a, 16a', 16b, 16b'), and where, in the bore of the sleeve parts (10a, 10b), is disposed an axially displaceable, tubular, spindle-like locking device (18) having corresponding locking means (28', 28'') which, in a first position of the locking device (18), the locking position, towards which the locking device (18) is pressed by means of a spring body (22), are in engagement with said longitudinal locking means (16a, 16a', 16b, 16b') of both sleeve parts (10a, 10b), in order to secure the mutual interconnection of the sleeve parts (10a, 10b) through screwing them together, and which, in a second position of the locking device (18), the release position, only engage the locking means (16b, 16b') of one sleeve part (10b), thus neutralizing the locking of the other sleeve part (10a), so that it can be unscrewed and removed from said one sleeve part (10b); leaving the locking device (18) in engagement with the latter sleeve part (10b) only, c h a r a c - t e r i z e d i n that all locking means consist of straight, axially extending grooves (16a, 16b, 28') and straight, axially extending, list-shaped projections (16a', 16b', 28'') without a wedge-in effect, wherein the locking means (16a, 16a') of one sleeve part (10a), in the end portion thereof, extend from a radial contact face common for the two sleeve parts (10a, 10b), axially away therefrom, from where the other sleeve part's (10b) locking means (16b, 16b') extend in the opposite direction, axially away therefrom, and that the locking means (28', 28'') of the locking device are gathered in a toothed rim-like portion, one sleeve part's (10a) straight, axially extending grooves (16a) being axially

aligned with the other sleeve part's (10b) straight, axially extending grooves (16b) and with the locking device's (18) straight, list-like projections (28"), while said one sleeve part's (10a) straight, list-like locking means (16a') are axially aligned with the other sleeve part's (10b) straight, axially extending projections (16b') and the locking device's (18) straight, axially extending grooves (28'), and that one axial end of the tubular, spindle-like locking device (18) has a seat (30) for a ball-shaped sealing body (32), for closing the through-going bore, in order to establish sealing conditions to enable hydraulical exertion of force against ball (32) and seat (30) in order to cause an axially directed displacement of the locking device (18) for the purpose of releasing.

2. A release piece as set forth in claim 1, characterized in that the wall of the sleeve part concerned is formed with a through-going, substantially radially directed oil supply/filling gate (34).

3. A release piece as set forth in any one of the preceding claims, characterized in that the locking means (28', 28") of the locking device (18) are formed on a concentric, thickened portion (28) having opposite, annular faces, of which one forms a stop face for one end of the spring (22), the other end of the spring (22) resting supportingly against an internal, radial stop face (24), defining a spring room (20) in one axial direction.

4. A release piece as set forth in one or more of the preceding claims, characterized in that those end portions (14a, 14b) of the sleeve parts (10a, 10b) which are adapted to be screwed together, are formed with co-operating right-hand threads, provided that the drill pipe sections included in the drill string are screwed together by means of left-hand threads, or vice versa.

5. A release piece as set forth in claim 4,

c h a r a c t e r i z e d   i n   that the end connectors (12a, 12b) of the release piece (10a,10b,18) have left-hand threads for the drill string, if the drill pipe sections of the drill string have right-hand threads.

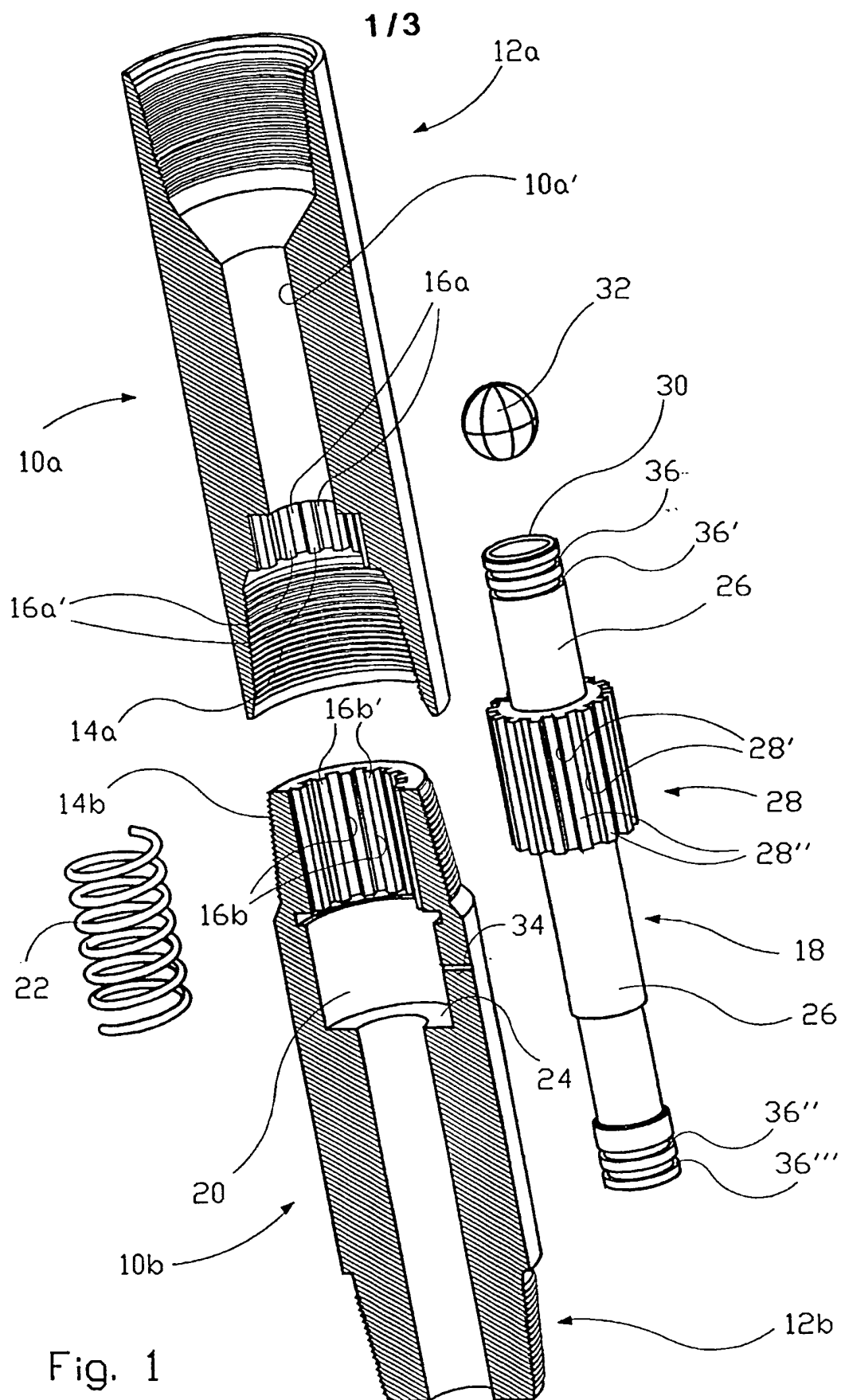


Fig. 1

2/3

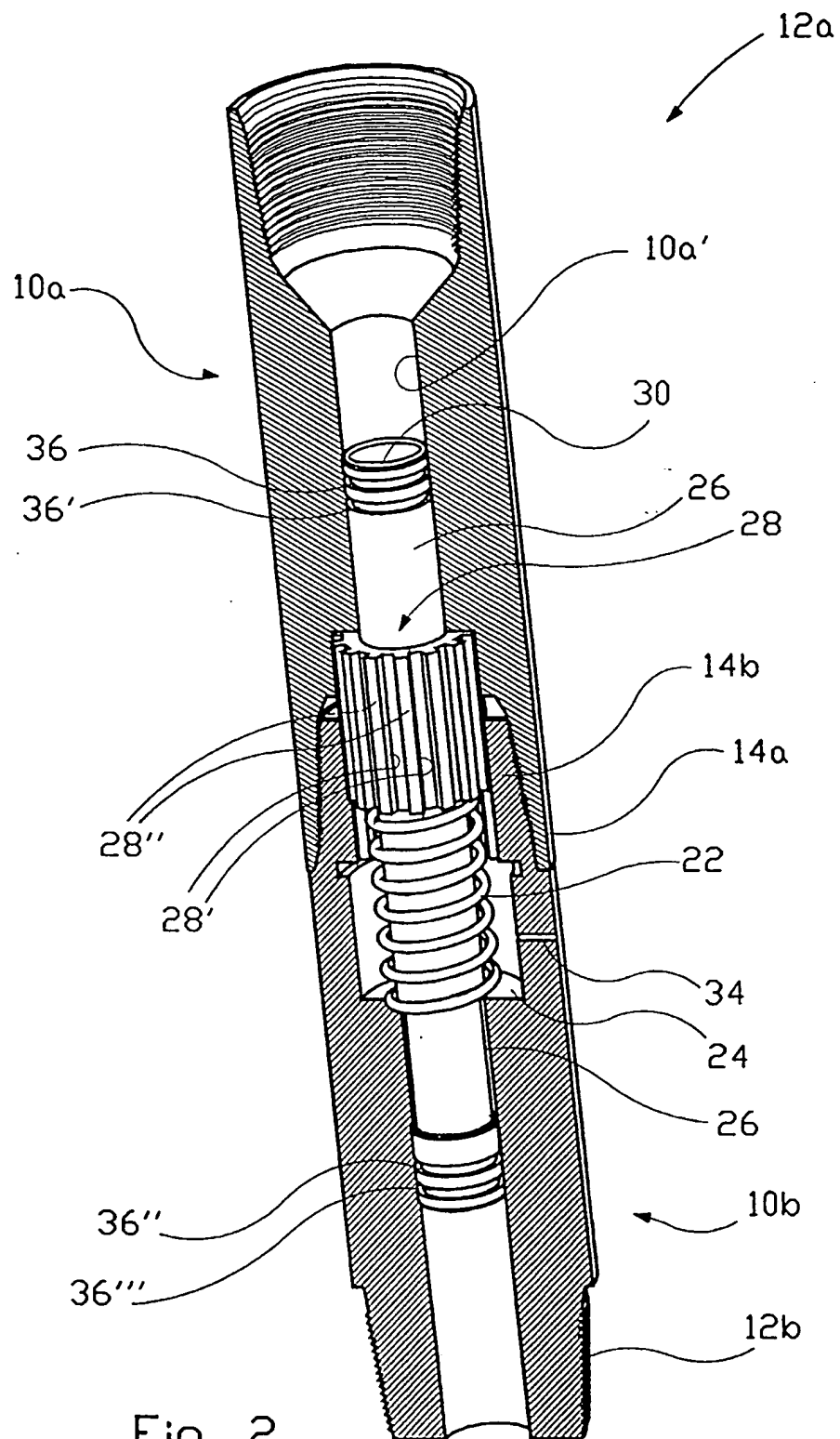
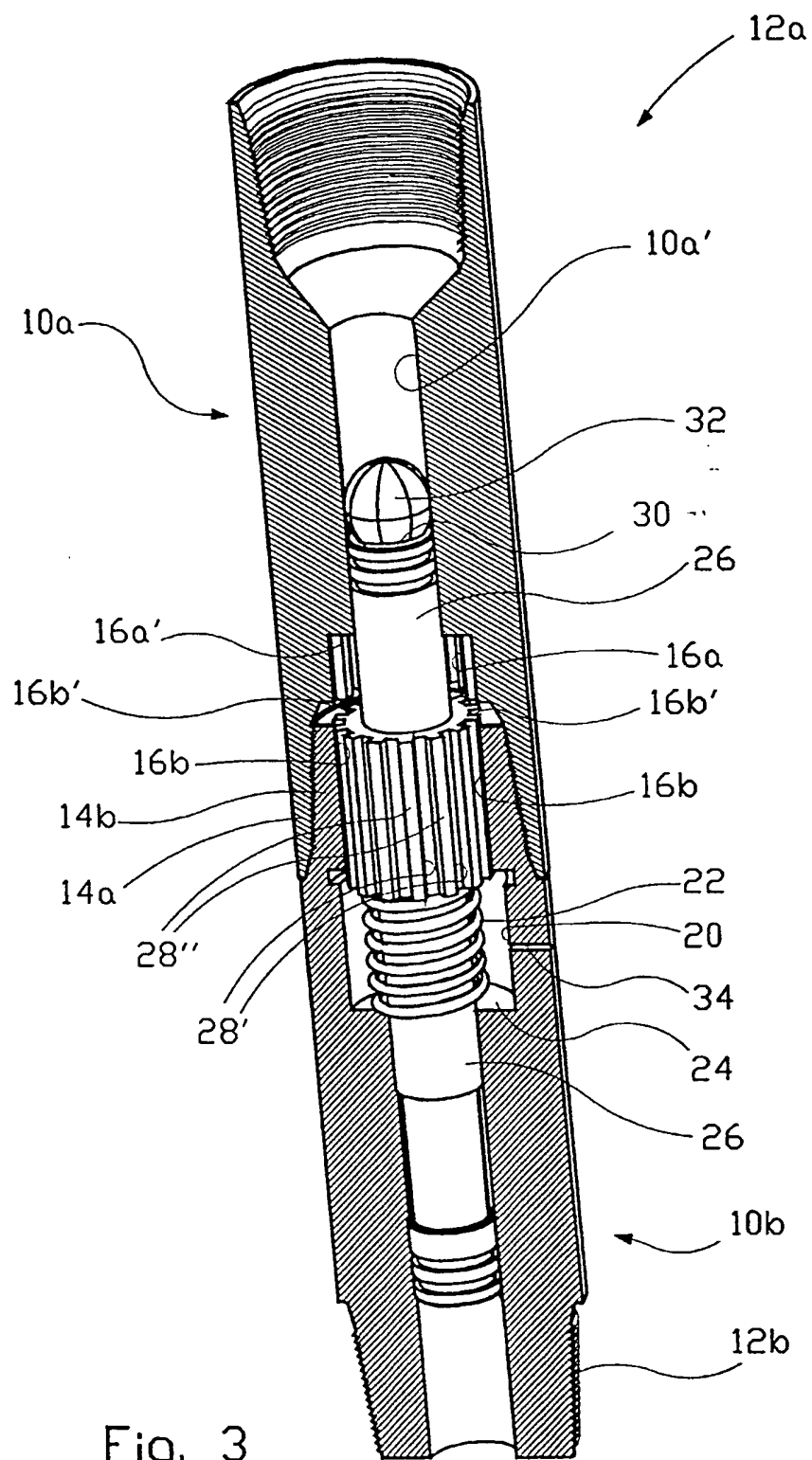


Fig. 2

**3 / 3**





# INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 98/00012

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: E21B 17/043, E21B 31/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 528255 C (DOHENY-STONE DRILL CO.), 26 June 1931 (26.06.31), page 1 - page 2, figures 1-3 --	1-5
A	EP 0244194 A2 (MOBIL OIL CORPORATION), 4 November 1987 (04.11.87) --	1-5
A	US 3895829 A (C.D. MANSON, JR.), 22 July 1975 (22.07.75) -- -----	1-5

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"I" earlier document but published on or after the international filing date

"I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 April 1998

Date of mailing of the international search report

12-05- 1998

Name and mailing address of the ISA:

Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Christer Bäcknert

Telephone No. +46 8 782 25 00

# INTERNATIONAL SEARCH REPORT

Information on patent family members

02/04/98

International application No.

PCT/NO 98/00012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 528255 C	26/06/31	GB 326893 A US 1883071 A	00/00/00 18/10/32
EP 0244194 A2	04/11/87	BR 8702074 A US 4693498 A	09/02/88 15/09/87
US 3895829 A	22/07/75	NONE	